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Determination of the Electrical Conductivity by Magnetotelluric Measurements

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The first results of MT sounding on the territory of Czechoslovakia were obtained from the data of the field station in Šrobárová where the horizontal electric and magnetic components of the field were recorded simultaneously over a range of period from 1 second to 24 hours. The field data were analysed a) by direct amplitude determination of PP, PC and other short-period variations. b) by harmonic analysis of the daily variation and groups of special types of short-period variations. c) by Fourier spectral analysis of bays, Pts and other non-periodic fluctuations.

The material obtained was interpreted on the assumption that the sources of all variations are of global dimensions (1). The impedance of a plane electromagnetic wave was computed for groups of variations of nearly equal periods in dependence on $\sqrt{T}$. From smoothed graphs $E/H = f(\sqrt{T})$ the resistivity curves ϱ_{zx} and ϱ_{zy} were derived according to the formula

$$(1) \qquad \varrho_{zx1y} = 0.2T \left| E_{x1y}/H_{y1x} \right|^2,$$

where ϱ is in Ωm, T in sec, E in mV/km, Hx, y in γ. Fig. 1 (not reproduced here) shows the curve $\varrho_{zy} = f(\sqrt{T})$ at Šrobárová (Š), another curve ϱ_{zx} could not be constructed in the short-period branch because data are lacking for periods T<20 sec. The two curves are identical within the limits of accuracy of their determination. In the same graph a part of curve from Budkov (the stationary observatory) and a curve taken from (2) are included. (Denotation US)

The short-period part of curve ϱ_{zy} corresponds to the geological conditions in the sufface parts of the neogene basin. An interpretation based on the two-layer theoretical curve gives 2 km for the depth of the non-conducting fundament. This estimate is in good agreement with local geoelectric resistivity prospecting.

The long-period branches of curves ϱ_{zx}, ϱ_{zy} show that a highly conductive layer may exist in the deeper part of the crust in the region under consideration. The interpretation was made from asymptotes. I. and II. corresponding to different smoothing of the function $E/H = f(\sqrt{T})$ over the range of periods $50 < \sqrt{T} < 120$. We get an average estimate of 138 km for the depth of this layer. Its resistivity must be of order 1 Ωm. The curve is very uncertain in the range of periods $170 < \sqrt{T} < 300$ because of the small number of determinations. We get higher resistivities than would be the case for monotonous decreasing of the resistivity following from bays. Resistivities are in the range of B and US curves. If this increase of resistivity were real the conductive layer, determined at a depth of 138 km would probably correspond to a zone of increased electrical conductivity, supposed by H. WIESE (3) at a depth of 50 - 150 km in Central Europe. According to his data the field station Srobarova may be in the neighborhood of this zone. Further data are required to support this conclusion.

References:

(1): L. Cagniard, Ann de Geophys., 9 (1953), 95.
(2): A. N. Tichonov, N.V. Lipskaja et all, DAN SSSR 140 (196 1), 41.
(3): H. Wiese, Tiefentellurik, Akademie-Verlag, 1956.

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